the one ovoid, as it were, isolated in the mucus and formed of glandular cells similar to those which enter into the structure of the epidermis, the other fusiform and with filaments at their extremity. The papillæ are joined to the body by long and slender peduncles.—— F. E. Beddard (*Ann. and Mag. Nat. Hist.*, Feb., 1886) describes three species of Perichæta and one of Moniligaster from Ceylon and the Philippines. The latter genus is remarkable for the apparent absence of a clitellum and the presence of five distinct gizzards in the œsophagus.

Protozoa.—A. C. Stokes (*Ann. and Mag. Nat. Hist.*) describes several New Infusoria from American fresh waters.——H. J. Carter describes in the January and February numbers of the *Ann. and Mag. of Nat. Hist.*, thirty-five species of sponges from the neighborhood of Port Phillip heads, South Australia.

EMBRYOLOGY.[1]

ON THE SYMMETRY OF THE FIRST SEGMENTATION FURROWS OF THE BLASTODISK OF ELASMOBRANCHII.—The nearly symmetrical subdivision of the blastodisk of Teleosts by the first four segmentation furrows has long been known. The details of the early development of the blastodisk of Teleosts have been very carefully elaborated by Agassiz and Whitman,[2] whose conclusions are, I believe, generally accepted by embryologists. Of the development of the blastodisk of Elasmobranchs we know comparatively little, especially in relation to the relative position and direction of the first segmentation furrows. The object of the present note will therefore be to describe the early segmentation of the blastodisk of one of the latter, viz., *Raia erinacea*, as displayed by an egg removed from the oviduct and cloaca of a female of that species, July 11, 1885, at Wood's Holl, Mass.

Upon opening the tough horny membranous envelope in which the ovum proper of Raia is enclosed, it is found that the egg is somewhat pinkish in color, and is imbedded in a layer of very glairy "white" or albumen, which fills up the space between the egg and the horny case. The pinkish egg proper is somewhat flattened and oval in shape, and is immediately invested by a very thin and delicate vitelline membrane. At one side of the flattened vitellus, which measures nearly one and a quarter inches through its longest diameter, a small circular whitish area about two millimeters in diameter is noticeable. This is the blastodisk or germinal area of authors, and is the point where development first begins to manifest itself.

If the egg case is carefully opened, the white removed and then laid into a one per cent solution of chromic acid, the blasto-

[1] Edited by JOHN A. RYDER, Smithsonian Institution, Washington, D. C.

[2] On the development of some pelagic fish-eggs. Proc. Am. Acad. Arts and Sci., XX, 1884.

disk may be hardened *in situ* without distortion, and afterwards separated from and carefully lifted off of the underlying vitellus, together with a thin hardened flake of the latter to support it. Such was the treatment to which the blastodisk here figured and described was subjected. The surface view, Fig. 1, was drawn with the camera lucida after hardening, and the section shown in Fig. 2 was drawn from one taken at about the position of the line *a* in Fig. 1. Cleavage had already advanced so far as to subdivide the area of the blastodisk into fifteen sharply defined cells, so that it may be assumed that this blastodisk has nearly completed its sixteen-celled stage of development or that the fourth cleavage is about completed.

A comparison of the first four cleavage planes of this blastodisk shows that they are formed in very nearly the same order and relation to each other in Elasmobranchs as in Teleosts. For example, the first plane I, in Fig. 1, has cut through the originally circular blastodisk and caused it to become elongated at right angles to the direction of the first segmentation furrow exactly as in the eggs of teleostean fishes. The second furrow, II, cuts the first at right angles so as to further subdivide the first two cells into four. The next cleavage is caused by two nearly parallel furrows, III, III, which appear simultaneously, and further subdivide the cells of the blastodisk into eight. The fourth cleavage is caused by two parallel furrows, IV, cutting the blastodisk approximately at right angles to the two furrows of the third cleavage. It thus results that sixteen cells will be developed, and it will be apparent also that the method of segmentation thus indicated is exactly comparable with that characteristic of the developing ova of teleosteans. We have, in fact, the same elongation of the blastodisk in one direction as is produced by the first segmentation furrow in the latter. The same oblong, squarish outline of the blastodisk as observed in the sixteen-celled stage of teleostean development is also obvious, and it is also evident that such a squarish configuration of the blastodisk does not disappear until the morula condition is reached or at least approximated, just as in Teleosts. These data serve to show that the features of segmentation as observed by several investigators in the eggs of Teleosts are repeated with no essential variation in the de-

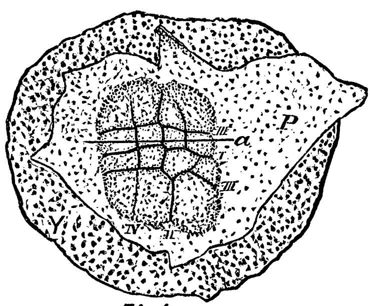

Fig. 1

Fig. 2

velopment of the eggs of the Elasmobranchs. The subdivision of the blastodisk into cells in both types of Ichthyes is essentially a symmetrical one, determined by the first cleavage plane. Whether or not the first cleavage plane of the ovum of elasmobranchs coincides with the median plane of the future embryo, as supposed by Whitman, Roux, Pflüger and E. Van Beneden, it is impossible to decide at present, but it would seem not at all improbable that such might be the case.

A series of sections of this blastodisk of Raia, prepared by the aid of a Cambridge rocking microtome, which was presented to the U. S. Fish Commission by Professor Adam Sedgwick, have enabled me to reach some interesting conclusions in reference to the structure of the blastoderm of the Elasmobranchii during its one-layered condition. At this stage the four median or central cells are not completely sundered from the underlying periblast, P, Fig. 2, since the cleavage furrows are found to terminate abruptly before they have quite cut through the finely granular plasma of the blastodisk proper, as shown in Fig. 2. In this respect the cleavage of the blastodisk of Elasmobranchs differs very decidedly from that of teleosts as described by Agassiz and Whitman in the paper already cited.

The germinal plasma of the disk is composed of a clear substance in which very fine granules are imbedded. These granules are probably of the same nature as the crystalloids or tabular crystal-like rigid bodies which largely enter into the composition of the yolk Y. In fact a careful examination reveals the fact that the very finely granular plasma of the segmenting blastodisk passes by insensible gradations into that of the yolk charged with very coarse granules or tablets. An exceedingly thin envelope of finely granular plasma, which is continuous with the margin of the blastodisk, covers the entire vitelline mass. This is represented by the irregular outline of the area P in Fig. 1, below which lies a discoidal mass of coarsely granular yolk, Y. In Fig. 2 the relations of the cortical layer P, or periblast, to the vitellus are still more distinctly shown, and it is very evident that the plasma of the blastodisk is continuous inferiorly with the vitelline mass, and that a cleavage cavity must be developed at a considerably later stage.

The lower limits of the segmentation furrows were very sharply defined, as shown in Fig. 2, and the nuclei of the constituent cells of the blastodisk were observed as clear round or oval areas in the plasma of the cells, and near the center of each one could be seen a very well marked nearly globular chromatin body, which occasionally was observed to be provided with irregular processes which extended outward into the nuclear space. No karyokinetic phenomena were observed.

From what has preceded it does not seem at all probable that the "free nuclei" which are finally developed under the blasto-

disk of Elasmobranchs originate spontaneously. It is indeed far more likely that they originate by a process of segmentation in which the marginal cells of the blastodisk are involved the same as in Teleosts. Such a view is in fact supported by fig. 15 given in Balfour's Comparative Embryology, Vol. II, p. 34, in which two free nuclear spindles are shown at the edge of the deeper-lying part of the blastodisk of Pristiurus in the morula condition, consisting of four superimposed rows of cells. Balfour's figure also shows that between the lowermost cells composing the blastodisk and the coarsely granular vitellus there is still a considerable unsegmented stratum of finely granular plasma interposed. In this lower layer of finely granular plasma alone the "free nuclei" are found, thus furnishing additional evidence that the view expressed above as to the origin of such nuclei is probably correct. In the disk of Raia examined by me the cleavage planes are also marked by the clear margins of adjacent cells, as in the blastodisk of Pristiurus figured by Balfour. The blastodisk of Raia here figured and described measured 1.71 millimeters in width and 2.37 millimeters in length. Its thickness in the center was about .6 of a millimeter, and thinned out at the margin into a very thin layer of plasma which is obviously homologous with the cortical or periblastic layer of the teleostean egg. Later stages of the blastodisk of Raia show it subdivided into smaller and more irregular cellular areas; the whole disk also again assumes much more nearly the original discoidal form characteristic of it previous to the beginning of segmentation. To judge from the condition of the blastodisk here described, it of course is to be inferred that the fertilization of the egg takes place while it is still in the oviduct, or possibly even before it enters the latter.—*John A. Ryder.*

PHYSIOLOGY.[1]

GLYCOGENIC FUNCTION OF THE LIVER.—I see that in your general notes on Physiology in the April number of the AMERICAN NATURALIST, p. 397, an abstract is given of Professor Seegen's researches on the glycogenic function of the liver. One of his most important conclusions is that peptones are destroyed in the liver by being split into liver-sugar and a nitrogenous residue. Now this is exactly the conclusion at which I arrived in my paper, "On the glycogenic function of the liver," published eight years ago.[2] In that paper I say (p. 102): "Therefore—and this is a very important point—*albuminoids are decomposed in the liver into glycogen and some nitrogenous matter* which is excreted partly in the bile but probably mostly restored to the blood to be excreted as urea by the kidney. In this way excess of albuminoid over and above what is necessary for build-

[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.
[2] *Am. Jour. Sci.*, Vol. XV, p. 99, 1878.